



National Aeronautics and
Space Administration

John C. Stennis Space Center
Stennis Space Center, MS 39529-6000

SSTD-8070-0137-WELD Rev. Basic
APRIL 2015

COMPLIANCE IS MANDATORY

JOHN C. STENNIS SPACE CENTER

FLUX CORED ARC WELDING

OF CARBON STEEL (P-NO 1, GROUP 1 OR 2)

FOR 1/8-INCH TO UNLIMITED PLATE

THICKNESS

Original signed by

<u>Scott Olive</u>	<u>4-2-15</u>
NASA SSC Center Operations	Date
Design & Construction Project	
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NASA SSC Center Operations Directorate	Date
Operations and Maintenance Division	

<u>Bartt J. Hebert</u>	<u>4-1-15</u>
NASA SSC Engineering & Test Directorate	Date

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NASA SSC Safety & Mission Assurance	Date

Issued by

<u>Issued CEF</u>	<u>4-7-15</u>
Central Engineering Files	Date

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Document History Log

Status/Change/ Revision	Change Date	Originator/Phone	Description
Basic	04.01.2015	Doug Dike x8-2803	Initial release. 1.0 and 2.0: Revised to reflect that this standard applies to structural use only. 3.0: Updated references to include AWS D1.1 and AWS 5.36.

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1.0 PURPOSE

This John C. Stennis Space Center (SSC) standard (SSTD) provides for a qualified American Society of Mechanical Engineers (ASME) and American Welding Society (AWS) weld procedure for Flux Cored Arc Welding (FCAW) of carbon steel; designated as P-No.1, Group 1 or 2 in ASME Boiler and Pressure Vessel Code, Section IX. This weld procedure is applicable to welding of carbon steel plate of 1/8-inch to unlimited thickness and pipe of nominal 24-inch diameter and larger with wall thickness of 1/8-inch and greater for structural use at SSC.

2.0 APPLICABILITY

- a. This SSTD applies to all contractor and subcontractor personnel involved with the FCAW welding of (P No. 1, Group 1 or 2) carbon steel plate and pipe for structural use at SSC.
- b. This SSTD is also valid for welding of (P No. 1, Group 1 or 2) carbon steel to (P No. 1, Group 1 or 2) carbon steel pipe, tube, fittings, or plate used in fluid services, provided that the produced welds are not fluid pressure boundary or pressure containing welds; e.g., carbon steel pipe supports or doubler plates welded to outer walls of carbon steel pipe and fittings being an allowed application of this standard.

3.0 REFERENCES AND APPLICABLE DOCUMENTS

Applicable documents shall be the latest version unless otherwise specified.

ASME Boiler and Pressure Vessel Code, Section II, Materials, Part A, *Ferrous Material Specifications*

ASME Boiler and Pressure Vessel Code, Section IX, *Welding, Brazing, and Fusing Qualifications*

AWS D1.1, *Structural Welding Code - Steel*

AWS 5.36, *Specification for Carbon and Low-Alloy Steel Flux Cored Electrodes for Flux Cored Arc Welding and Metal Cored Electrodes for Gas Metal Arc Welding*

SPR 1440.1, *SSC Records Management Program Requirements*

SPR 8715.1, *SSC Safety and Health Program Requirements*

SSTD-8070-0005-CONFIG, *Preparation, Review, Approval and Release of SSC Standards*

SSTD-8070-0013-WELD, *Classes of Welding Inspection*

SSTD-8070-0014-WELD, *Qualifying Welders and Welding Procedures*

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4.0 RESPONSIBILITIES

Responsibilities for the use and control of this SSTD and for the review and approval of revisions or cancellation of this SSTD shall be as specified in SSTD-8070-0005-CONFIG and the applicable documents referenced therein.

5.0 REQUIREMENTS AND PROCEDURES

- a. All procedures shall be performed in compliance with applicable requirements in SPR 8715.1. If ever there is a conflict between this SSTD and the SPR, the SPR takes precedence.
- b. Items denoted as essential variables in the attached weld procedure specifications (WPS) shall not be altered when using the WPS. An alternate WPS may be used only if approved prior to use by the NASA SSC Center Operations Directorate Project Management Division (PMD), the NASA SSC Engineering and Test Directorate (E&TD), and the NASA SSC Safety and Mission Assurance (S&MA) Office.
- c. The attached NASA-A36-FCAW(A) Procedure Qualification Record (PQR) is the PQR for the original WPSs in this SSTD. When performing new qualifications, a new, approved PQR shall be completed showing all pertinent data and results of the weld procedure qualification.
- d. Welders shall be qualified in accordance with SSTD-8070-0014-WELD.
- e. Inspection methods for welds shall be in accordance with SSTD-8070-0013-WELD.
- f. Qualification tests shall be performed on test coupons welded with backing plates.

6.0 RECORDS AND FORMS

- a. Records required by the procedures of this SSTD shall be maintained in accordance with SPR 1440.1 and as specified in this SSTD.
- b. All records and forms are the latest version unless otherwise indicated.
- c. The original, signed WPS and PQR (copies of which are provided in Attachments A of this SSTD) and the accompanying Certificate of Analysis validation test document shall be maintained in Central Engineering Files (CEF), together with the original, signed hardcopy of this SSTD.

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7.0 ACRONYMS AND ABBREVIATIONS

ASME	American Society of Mechanical Engineers
AWS	American Welding Society
CEF	Central Engineering Files
E&TD	Engineering and Test Directorate
FCAW	Flux Cored Arc Welding
NASA	National Aeronautics and Space Administration
PMD	Project Management Division
PQR	Procedure Qualification Record
PQRD	Procedure Qualification Record Data
S&MA	Safety and Mission Assurance
SPR	John C. Stennis Space Center Procedural Requirement
SSC	John C. Stennis Space Center
SSTD	John C. Stennis Space Center Standard
WPS	Weld Procedure Specifications

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ATTACHMENT A

A1: WPS NASA-A36-FCAW

FORM QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATIONS (WPS) (See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Organization Name	Jacobs Technology	By	L. deQuay
Welding Procedure Specification No.	NASA-A36-FCAW	Date	2/25/15
Revision No.	1	Date	2/25/15
		Supporting PQR No.(s)	NASA-A36-FCAW (A)
Welding Process(es)	FCAW	Type(s)	Semi-Automatic (Automatic, Manual, Machine, or Semi Automatic)

JOINTS (QW-402)		Details
Joint Design	Single V-Groove	
Root Spacing		
Backing: Yes	X	No
Backing Material (Type)	AWS D1.1 Table 3.1 Groups I or II (Refer to both backing and retainers)	
<input type="checkbox"/> Metal	<input type="checkbox"/> Nonfusing Metal	See attachment #1, Note #1
<input type="checkbox"/> Nonmetallic	<input type="checkbox"/> Other	
Sketches, Production Drawings, Weld Symbols, or Written Description should show the general arrangement of the parts to be welded. Where applicable, the details of weld groove may be specified.		
Sketches may be attached to illustrate joint design, weld layers, and bead sequence (e.g., for notch toughness procedures, for multiple process procedures, etc.)		

*BASE METALS (QW-403)			
P-No.	1	Group No.	1 or 2
OR	Specification and type/grade or UNS Number		
to Specification and type/grade or UNS Number	See Attachment #1, Note #1		
OR	Chem. Analysis and Mech. Prop.		
to Chem. Analysis and Mech. Prop.			
Thickness Range:			
Base Metal:	Groove	0.125" thru Unlimited	Fillet
Maximum Pass Thickness $\leq \frac{1}{2}$ in. (13 mm)	(Yes)		(No)
Other			

*FILLER METALS (QW-404)		
Spec. No. (SFA)	1	2
AWS No. (Class)	E71T1-M21A0-CB1 or E71T1-M21A2-CB2	
F-No.		
A-No.		
Size of Filler Metals	0.062	
Filler Metal Product Form		
Supplemental Filler Metal		
Weld Metal		
Deposited Thickness:	0.125" thru Unlimited	
Groove		
Fillet	Unlimited	
Electrode-Flux (Class)		
Flux Type		
Flux Trade Name		
Consumable Insert		
Other		

*Each base metal-filler metal combination should be recorded individually.

(07/13)

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FORM QW-482 (Back)

WPS No. NASA-A36-FCAW Rev. 1

POSITIONS (QW-405) Position(s) of Groove _____ 1G _____ Welding Progression: Up _____ N/A _____ Down _____ N/A _____ Position(s) of Fillet _____ 2F _____ Other _____				POSTWELD HEAT TREATMENT (QW-407) Temperature Range _____ N/A _____ Time Range _____ N/A _____ Other _____																										
PREHEAT (QW-406) Preheat Temperature, Minimum _____ 320° F _____ Interpass Temperature, Maximum _____ 500° F _____ Preheat Maintenance _____ 320° F _____ Other _____ <small>Maintain 320°F for 24 hours. (Continuous or special heating, where applicable, should be recorded.) Immediately after final pass is completed, then slow cool to ambient temperature.</small>				GAS (QW-408) <table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="3">Percent Composition</th> </tr> <tr> <th>Gas(es)</th> <th>(Mixture)</th> <th>Flow Rate</th> </tr> </thead> <tbody> <tr> <td>Shielding</td> <td>Argon/CO₂</td> <td>75%/25%</td> <td>30-60 CFH</td> </tr> <tr> <td>Trailing</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Backing</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Other</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> </tbody> </table>					Percent Composition			Gas(es)	(Mixture)	Flow Rate	Shielding	Argon/CO ₂	75%/25%	30-60 CFH	Trailing	_____	_____	_____	Backing	_____	_____	_____	Other	_____	_____	_____
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Backing	_____	_____	_____																											
Other	_____	_____	_____																											
ELECTRICAL CHARACTERISTICS (QW-409)																														
Weld Pass(es)	Process	Filler Metal Classification	Diameter	Current Type and Polarity	Amps (Range)	Wire Feed Speed (Range)	Energy or Power (Range)	Volts (Range)	Travel Speed (Range)	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, etc.)																				
Root	FCAW	E71T1-M 21A0-CS 1	0.052	DCEP		157 in/min		24.5-30	9 IPM																					
2-Cap	FCAW	E71T1-M 21A0-CS 1	0.052	DCEP		155 in/min		24.5-30	8-15 IPM																					
Amps and volts, or power or energy range, should be recorded for each electrode size, position, and thickness, etc.																														
Pulsing Current _____ Heat Input (max.) _____ Tungsten Electrode Size and Type _____ <small>(Pure Tungsten, 2% Thoriated, etc.)</small> Mode of Metal Transfer for GMAW (FCAW) _____ <small>(Spray Arc, Short Circuiting Arc, etc.)</small> Other _____ <small>Power Supply: CV (Constant Voltage)</small>																														
TECHNIQUE (QW-410) String or Weave Bead _____ <small>Both (weave, & 5%)</small> Orifice, Nozzle, or Gas Cup Size _____ <small>1/8"-3/16"</small> Initial and Interpass Cleaning (Brushing, Grinding, etc.) _____ <small>Grinding, power brush</small> Method of Back Gouging _____ <small>None</small> Oscillation _____ Contact Tube to Work Distance _____ <small>1/8" to 1"</small> Multiple or Single Pass (Per Side) _____ <small>Multiple</small> Multiple or Single Electrodes _____ <small>Single</small> Electrode Spacing _____ Peening _____ <small>Not allowed</small> Other _____ No pass greater than 1/2" disposition. Joint Prep - Flame cut and light grinding on surfaces to be welded.																														

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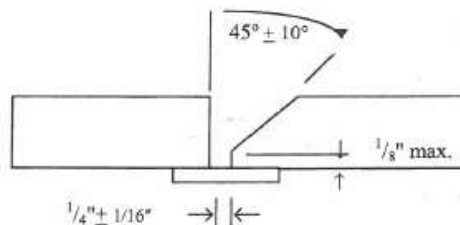
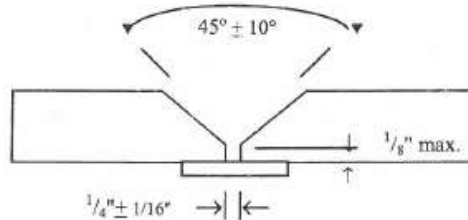


WPS# NASA-A36-FCAW
ATTACHMENT # 1

Note # 1 AWS D1.1 Any Group I to Any Group I
 Any Group II to Any Group I
 Any Group II to Any Group II

Joint Detail

Note: Maximum plate misalignment is $\pm 1/4"$



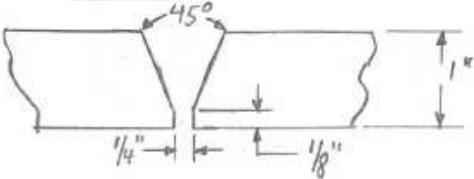
Travis G Moore

 Travis G Moore
 CV# 99041251
 QC1 EXP. 4/1/2014

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A2: PQR NASA-A36-FCAW(A)

FORM QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORDS (PQR) (See QW-200.2, Section IX, ASME Boiler and Pressure Vessel Code) Record Actual Variables Used to Weld Test Coupon

Organization Name _____ Jacobs Technology																													
Procedure Qualification Record No. _____ NASA-A36-FCAW (A)	Date _____ Revised 2/25/15																												
WPS No. _____ NASA-A36-FCAW																													
Welding Process(es) _____ FCAW																													
Types (Manual, Automatic, Semi-Automatic) _____ Semi-Automatic																													
JOINTS (QW-402)																													
 <p>Note: See attachment for test recorded weld passes.</p> <p>Groove Design of Test Coupon (For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal and process used.)</p>																													
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<table border="1"> <tr> <td colspan="2">PREHEAT (QW-406)</td> </tr> <tr> <td>Preheat Temperature _____ 320° F</td> <td></td> </tr> <tr> <td>Interpass Temperature _____ 320° F min. to 442° F max</td> <td></td> </tr> <tr> <td>Other Temperature of 320° F minimum was maintained for 2 1/2 hours immediately after completion of final pass.</td> <td></td> </tr> </table>		PREHEAT (QW-406)		Preheat Temperature _____ 320° F		Interpass Temperature _____ 320° F min. to 442° F max		Other Temperature of 320° F minimum was maintained for 2 1/2 hours immediately after completion of final pass.																					
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(07/13)

Stennis Standard	SSTD-8070-0137-WELD	Basic
	Number	Rev.
	Effective Date:	April 1, 2015
	Review Date:	April 1, 2020
Page 11 of 12		
Responsible Office: NASA SSC Center Operations Directorate		
SUBJECT: Flux Cored Arc Welding of Carbon Steel (P-No 1, Group 1 or 2) for 1/8-inch to Unlimited Plate Thickness		

PROCEDURE QUALIFICATION RECORD (PQR) # NASA-A36-FCAW (A)
TEST RESULTS Revised 2/25/2015

TENSILE TEST

Specimen No.	Width	Thickness	Area	Ultimate Tensile Load, lb	Ultimate Unit Stress, psi	Character of Failure and Location
7319.90(1) T-1	0.751"	1.211"	0.9095"	71,028	78,096	Base
7319.90(1) T-2	0.752"	1.205"	0.9062"	70,835	78,167	Base

GUIDED BEND TEST

Specimen No.	Type of Bend	Result	Remarks
7319.90(1)	Side Bend	Acceptable	
7319.90(1)	Side Bend	Acceptable	
7319.90(1)	Side Bend	Acceptable	
7319.90(1)	Side Bend	Acceptable	

VISUAL INSPECTION

Appearance Acceptable
 Undercut None
 Piping Porosity None
 Convexity Acceptable
 Test Date 1/31/14
 Witnessed By Travis G. Moore

Radiographic, Magnetic & Visual Examination

RT Report No. 86835 Result Acceptable
 MT Report No. 11500 Result Acceptable
 VT Report No. 12998 Result Acceptable

FILLET WELD TEST RESULTS

Minimum size multiple pass Maximum size single pass
 Macro-etch Macro-etch
 1. N/A 3. N/A 1. N/A 3. N/A
 2. N/A 2. N/A

Other Tests

All-Weld-Metal Tension Test

Tensile Strength, psi N/A
 Yield Point/Strength, psi N/A
 Elongation in 2 in., % N/A
 Laboratory Test No. N/A

Welder's Name Casey Deschamp Soc. Sec. No. 2778 Stamp No. JT-43

Tests Conducted By Inspection Specialists, Inc. - MTL Div.

Test Number 7319.90(1)

Per Travis G Moore



Travis G Moore
 CWI 98041251
 QC1 EXP. 3/1/2014

Travis G Moore

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section 4, Part B of ANSI/AWS D1.1 (2010) Structural Welding Code-Steel.

Signed

Jacobs

Manufacturer or Contractor

By

Benjamin A. McElb

Title


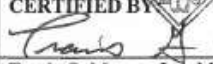
NDT - LUTHE / CWI

Date

2-13-14

Stennis Standard	SSTD-8070-0137-WELD	Basic
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A3: Certificate of Analysis

 INSPECTION SPECIALISTS, INC. MECHANICAL TESTING LABORATORY DIVISION						
CERTIFICATE OF ANALYSIS						
Client: <u>Jacobs Technology</u>			Job No: <u>7319.90</u>			
Client Representative: <u>Benny McGrath</u>			Purchase Order: _____			
Test Specification: <u>AWS D1.1</u>						
Sample Identification: <u>One (1) 1.250" Plate</u>			<u>WPS # NASA-A36-FCAW</u>		<u>PQR # NASA-A36-FCAW (A)</u>	
<u>Welder: Casey Deschamp</u>			<u>Stamp "JT-43"</u>		<u>ASTM A-36</u>	
The above referenced sample was prepared and tested in accordance with the welding procedure qualification requirements of AWS D1.1. Two (2) tensile test specimens and four (4) guided bend test specimens were prepared and tested. Prior to mechanical testing the samples was x-rayed. The results of these tests are reported herein.						
TENSILE TEST						
SPECIMEN ID	WIDTH INCHES	THICKNESS INCHES	AREA SQ. IN.	ULTIMATE LOAD POUNDS	TENSILE STRENGTH PSI	NATURE OF FRACTURE
7319.90(1) T-1	0.751"	1.211"	0.9095"	71,028	78,096	Base
7319.90(1) T-2	0.752"	1.205"	0.9062"	70,835	78,167	Base
GUIDED BEND TEST						
SPECIMEN ID	TYPE TEST		TEST RESULT			
7319.90(1) S1	Side Bend		Acceptable			
7319.90(1) S2	Side Bend		Acceptable			
7319.90(1) S3	Side Bend		Acceptable			
7319.90(1) S4	Side Bend		Acceptable			
RADIOGRAPHIC EXAMINATION: Acceptable (Report # 86835) MAGNETIC EXAMINATION: Acceptable (Report # 11500) VISUAL EXAMINATION: Acceptable (Report # 12998)						
The tests expressed herein meet or exceed the requirements of AWS D1.1						
CERTIFIED BY  Travis G. Moore, Lab Manager		Travis G. Moore CWI 99041251 QC1 EXP. 4/1/2014		Date: <u>February 3, 2014</u> Certificate No: <u>1</u> of <u>1</u>		
ALL TEST SPECIMENS, SAMPLES, DROPS, ETC. WILL BE DISCARDED THIRTY (30) DAYS AFTER TESTING UNLESS OTHERWISE INSTRUCTED IN WRITING.						